Clouds and the Earth's Radiant Energy System (CERES)

Data Management System

CERES Instantaneous SARB (Subsystem 5.0)

Release 2 Test Plan Version 2

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 Introduction

The Clouds and the Earth's Radiant Energy System (CERES) is a key component of the Earth Observing System (EOS). The CERES instruments are improved models of the Earth Radiation Budget Experiment (ERBE) scanner instruments, which operated from 1984 through 1990 on the National Aeronautics and Space Administration's (NASA) Earth Radiation Budget Satellite (ERBS) and on the National Oceanic and Atmospheric Administration's (NOAA) operational weather satellites NOAA-9 and NOAA-10. The strategy of flying instruments on Sun-synchronous, polar orbiting satellites, such as NOAA-9 and NOAA-10, simultaneously with instruments on satellites that have precessing orbits in lower inclinations, such as ERBS, was successfully developed in ERBE to reduce time sampling errors. CERES will continue that strategy by flying instruments on the polar orbiting EOS platforms simultaneously with an instrument on the Tropical Rainfall Measuring Mission (TRMM) spacecraft, which has an orbital inclination of 35 degrees. In addition, to reduce the uncertainty in data interpretation, and to improve the consistency between the cloud parameters and the radiation fields, CERES will include cloud imager data and other atmospheric parameters. The first CERES instrument is scheduled to be launched on the TRMM spacecraft in 1997. Additional CERES instruments will fly on the EOS-AM platforms, the first of which is scheduled for launch in 1998, and on the EOS-PM platforms, the first of which is scheduled for launch in 2000.

1.1 Document Overview

This document, the CERES Release 2 Delivery Test Plan for the CERES Instantaneous Surface and Atmospheric Radiation Budget (SARB) Subsystem (Subsystem 5.0), provides a description of the CERES Instantaneous SARB Subsystem Release 2 software and supporting data files, and explains the procedures for installing, executing, and testing the software. A section is also included on validating the results of executing the software.

The document is organized as follows:

1.2 Subsystem Overview

While the number of possible measurements per scan line is dependent upon platform, the scan line of a CERES instrument scanner will consist of up to 225 Earth-viewing measurements. The area viewed on the Earth for an individual measurement is referred to as a CERES footprint. The CERES Instantaneous SARB Subsystem will consist of software developed to compute the vertical

atmospheric profiles of shortwave and longwave radiative fluxes for the Earth-viewing CERES footprints in one-hour segments from each satellite. For each footprint, this vertical profile will extend from the Earth's surface to the top-of-the-atmosphere (TOA) and will comprise the surface and atmospheric radiation budget. Given the TOA fluxes as derived by the CERES inversion process and stored on the Single Satellite Fluxes (SSF) product, this Subsystem will implement radiative transfer algorithms to produce an initial, or untuned, set of fluxes. Noting that the radiative transfer algorithms are imperfect, a set of TOA balanced fluxes will be computed by adjusting different input parameters, such as cloud properties and precipitable water. While an exact match is not likely, the initial fluxes are tuned until the results more closely agree with the CERES TOA. The tuned fluxes, along with the adjustments made to the initial fluxes and various parameters in the tuning process, are stored on the Cloud and Radiation Swath (CRS) file.

Once subsystem processing for the SARB Subsystem has been initialized, data from the SSF product are ingested one footprint at a time, and then the vertical profiles are calculated and written to the CRS file. To calculate this vertical profile, ancillary data from the Meteorological, Ozone, and Aerosol (MOA) input files are used, along with a file of surface albedos. For the tuning process, additional input from the empirically precomputed Derivative Tables (DRIVTAB) product are used. Once data for all of the SSF footprints have been processed, the SARB Subsystem will perform the necessary finalization procedures. (The SARB Subsystem is numbered as 5.0 in the CERES subsystem numbering scheme. Process numbers and some file names used by this Subsystem will reflect this numbering scheme.)

2.0 Test Environment

2.1 External Interface Requirements

The input data provided for the Instantaneous SARB testing contains a sample SSF file recently obtained from the CERES Clouds Working Group. This sample file was generated using the CERES footprint and Point Spread Function (PSF).

The CERES library (CERESlib) Fortran 90 modules used by the Instantaneous SARB Subsystem software are listed in Table 2-1.

Table 2-1. CERESlib Routines Used by the Instantaneous SARB Subsystem

File Name	Description
CRS_IO	Provides the CRS data structure and I/O routines
ceres_constants	Provides commonly used constants for CERES code
ceres_defaults	Provides system-defined CERES default values
ceres_meteor	Provides routines for manipulating meteorological data (May not be in DAAC version of CERESlib at time of delivery for this Subsystem)
ceres_status	Provides a common set of file and return statuses
f90_kind	Provides FORTRAN 90 compiler-specific KIND values
io	Provides Toolkit IO wrappers
MOA_IO	Provides MOA data structure and I/O routines
msg	Provides interface to the Status Message Facility (SMF) Toolkit
pcf	Provides run-time parameter from a Process Control File (PCF)
SARB_Params	Provides SARB Subsystem's output parameters
ssf_meta	Provides interface to SSF metadata
ssf_typdef	Provides the SSF data structure and I/O routines

2.2 Directory Structure and File Descriptions

In addition to the tar file containing this document, the CERES Instantaneous SARB Subsystem Release 2 delivery package will contain three compressed tar files. InstSARB_src_R2-046.tar.Z contains FORTRAN source code, error message files, and other formatted files necessary for Subsystem execution. InstSARB_anc_R2-046.tar.Z.tar.Z contains the ancillary input data sets, formatted and binary, necessary for Subsystem execution. InstSARB_data_R2-046.tar.Z contains the hourly binary SSF input file and CRS output file generated at the Science Computing Facility (SCF) for comparison against the CRS file generated by the Langley DAAC during Subsystem Integration and Testing (SSI&T). Appendix A contains an acronyms and abbreviations list. The directory structures of the untarred files are shown in Appendix B. The contents of the tar files are categorized according to software files and input and output data file types. A description of the contents of each file included in the delivery package can be found in Appendix C.

3.0 Software and Data File Installation Procedures

This section describes how to install both the SARB library and the Subsystem 5.0 Instantaneous SARB software in preparation for making the necessary test runs at the Langley DAAC. The installation procedures include instructions for uncompressing and untarring the Instantaneous SARB files, properly defining environmental variables, and compiling the Instantaneous SARB programs.

3.1 Installation

Software/Data File Install Procedure:

1. The scripts, makefiles, and Process Control files in the Subsystem 5 delivery package expect the following environment variables, found in the $CERESENV script, to be defined:

   PGSDIR - Directory for Toolkit libraries
   F90 - SGI Fortran 90 compiler
   FCOMP - Fortran 77 compilation flags (-O3 -c -64)
   CERESHOME - Top Directory for CERES Software
   CERESLIB - Directory for CERESlib
   PGSINC - Pointer to the PGS Include file directory
   PGSLIB - Directory which contains the SGI 64-bit Toolkit library file
   PGSMSG - Directory location of Toolkit runtime message files
   F90COMP - SGI Fortran 90 compilation flags (-w -mp -O3 -c -64)

2. Change directory to the directory where you plan to install the SARB Subsystems. (The following instructions assume that the directory will be **$CERESHOME.**)
3. Uncompress and untar the SARB library and Instantaneous SARB Subsystem files on your machine:

   > uncompress InstSARB_src_R2-046.tar.Z
   > tar xf InstSARB_src_R2-046.tar
   > uncompress InstSARB_anc_R2-046.tar.Z
   > tar xf InstSARB_anc_R2-046.tar
   > uncompress InstSARB_data_R2-046.tar.Z
   > tar xf InstSARB_data_R2-046.tar
   > uncompress InstSARB_doc_R2-046.tar.Z
   > tar xf InstSARB_doc_R2-046.tar

3.2 Compilation

1. The Status Message Files can be made by typing:

   > cd $CERESHOME/sarb/smf/sarb
   > make

2. The SARB Library can be made by typing:

   > cd $CERESHOME/sarb/lib/src
   > make -f Makefile.CRS

3. The Subsystem 5.0 executable can be made by typing:

   > cd $CERESHOME/sarb/src/sarb
   > make

4.0 Test and Evaluation Procedures

This section provides general information on how to execute the Instantaneous SARB Subsystem 5.0.

4.1 Stand Alone Test Procedures

1. Execute the production script by typing:

   > $CERESHOME/sarb/bin/sarb/runsarb 1997122800

   Four files will be created:

   $CERESHOME/sarb/data/out_comp/data/sarb/CER_CRSB_TRMM-PFM VIRS_ValidationR1_000000.1997122800

   $CERESHOME/sarb/data/out_comp/data/sarb/CER_HSALU_TRMM-PFM-VIRS_ValidationR1_000000.1997122800

   $CERESHOME/sarb/data/out_comp/qa_reports/CER_HQCR_TRMM-PFM-VIRS-ValidationR1_000000.1997122800

   $CERESHOME/sarb/data/out_comp/data/sarb/CER_CRSB_TRMM-PFM VIRS_ValidationR1_000000.1997122800.met

   The software takes at least an hour to run to completion.

4.2 Normal Operating Procedures

Before CERES Subsystem 5.0 can be executed in production, input for the appropriate hour of data must be available from the successful execution of CERES Subsystems 4.5, 4.6, and 12. The SSF produced by the CERES Inversion to Instantaneous TOA Fluxes and Empirical Estimates of Surface Radiation Budget Subsystems 4.5 and 4.6 and profiles for appropriate hour of data from a MOA product, which is produced by Subsystem 12, are required input.

4.3 Procedure for Execution of Comparison Software

4.3.1 Exit Codes

An exit code of zero indicates that the execution ran and ended successfully and an exit code that is not zero indicates that a problem arose during execution and the run did not end successfully.

4.3.2 Log and Status File Results

Any error messages will be written to LogReport under $CERESHOME/sarb/data/runlogs.

4.3.3 Execution of Comparison Software

This section provides information on how to compile and execute the comparison software for the Instantaneous SARB Subsystem 5.0.

1. Execute the following to compile and run comparison software:

   > cd $CERESHOME/sarb/test_suites/sarb
   > make
   > crscomp.exe

   One file will be created:

   $CERESHOME/sarb/test_suites/sarb/CER_CRSB_TRMM-PFM-VIRS_ValidationR1_000000.1997122800.Diag

4.3.4 Evaluation of Comparison Software Output

This section provides the procedure for evaluating the output from the Instantaneous SARB Subsystem 5.0.

1. Examine the comparison report file

   > more $CERESHOME/sarb/test_suites/sarb/CER_CRSB_TRMM-PFM-VIRS_ValidationR1_000000.1997122800.Diag

   If all goes well, there will be a line indicating that no mismatches were found when comparing the results produced by the Langley DAAC with those produced by the CERES team. Some mismatches might occur due to computer precision, thus, there is no need for immediate alarm. Just perform Step 2.

2. E-mail the file **$CERESHOME/sarb/test_suites/sarb/CER_CRSB_TRMM-PFM-VIRS_ValidationR1_000000.1997122800.Diag** to Lisa Coleman, l.h.coleman@larc.nasa.gov and Shalini Gupta, s.gupta@larc.nasa.gov.

4.4 Solutions to Possible Problems

1. All four output files must be deleted or renamed in order to run the production software properly again.
2. Environment variables, FCOMP and F90COMP, must be set to the following SGI compiler options:

   > setenv F90COMP ‘-w -mp -O3 -c -64’
   > setenv FCOMP ‘-O3 -c -64’

   Compiler warnings will be generated and runtime problems may occur if these compiler options are not properly set.

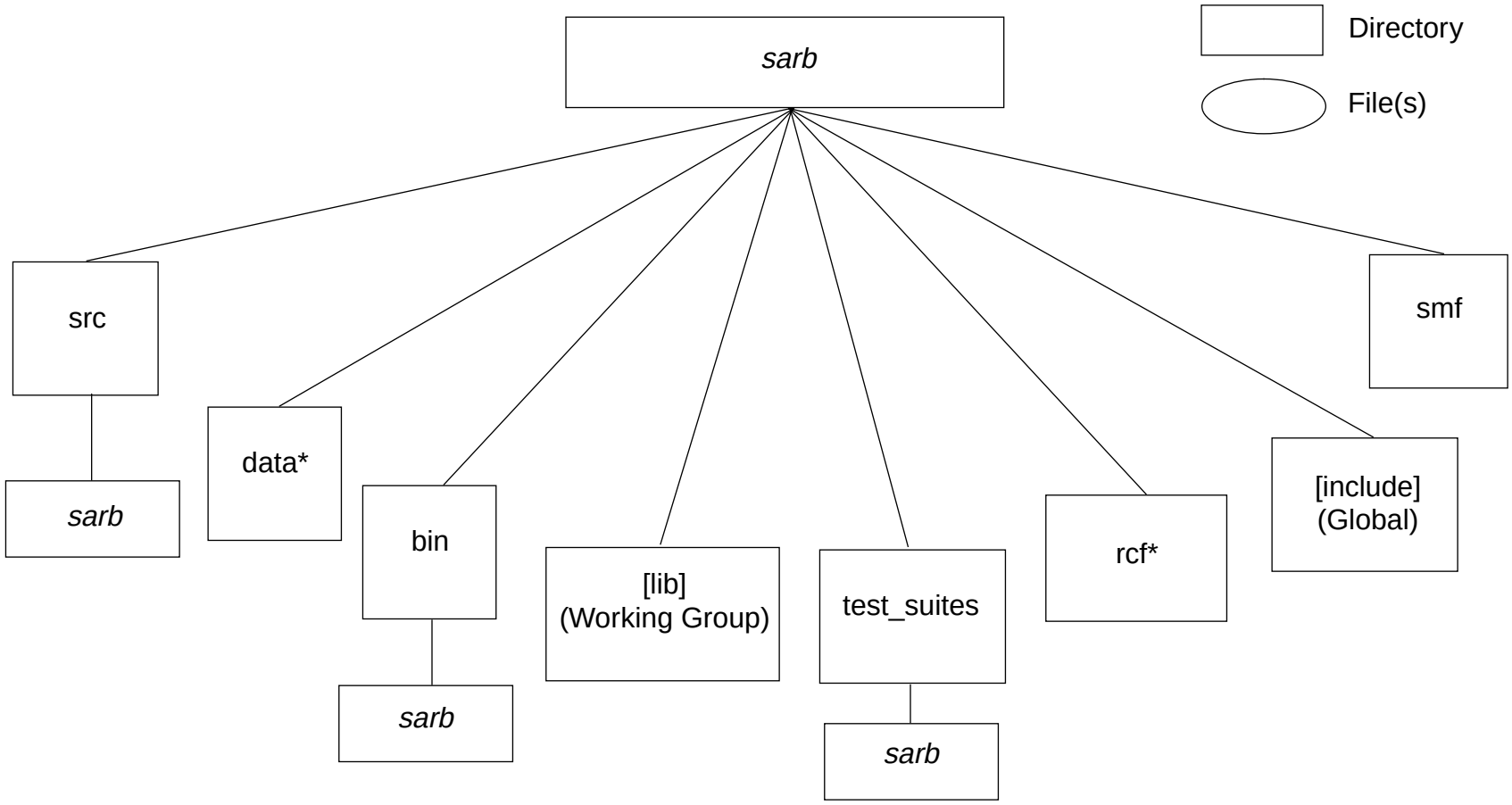
APPENDIX A
Acronyms and Abbreviations

Appendix A
Acronyms and Abbreviations

CERES	Clouds and the Earth's Radiant Energy System
CERESlib	CERES library
CRS	Clouds and Radiation Swath
DAAC	Distributed Active Archive Center
DRIVTAB	Derivative Table
EOS	Earth Observing System
EOS-AM	EOS Morning Crossing Mission
EOS-PM	EOS Afternoon Crossing Mission
ERBE	Earth Radiation Budget Experiment
ERBS	Earth Radiation Budget Satellite
LaTIS	Langley TRMM Information System
MCF	Metadata Control Files
MOA	Meteorological, Ozone, and Aerosol
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
PCF	Process Control File
PSF	Point Spread Function
SARB	Surface and Atmospheric Radiation Budget
SCF	Science Computing Facility
SMF	Status Message Facility
SSF	Single Satellite Fluxes
SSI&T	Subsystem Integration and Testing
TOA	Top of the Atmosphere
TRMM	Tropical Rainfall Measuring Mission

APPENDIX B
Directory Structure Diagrams

BREAKDOWN OF THE INSTANTANEOUS SARB DIRECTORY STRUCTURE



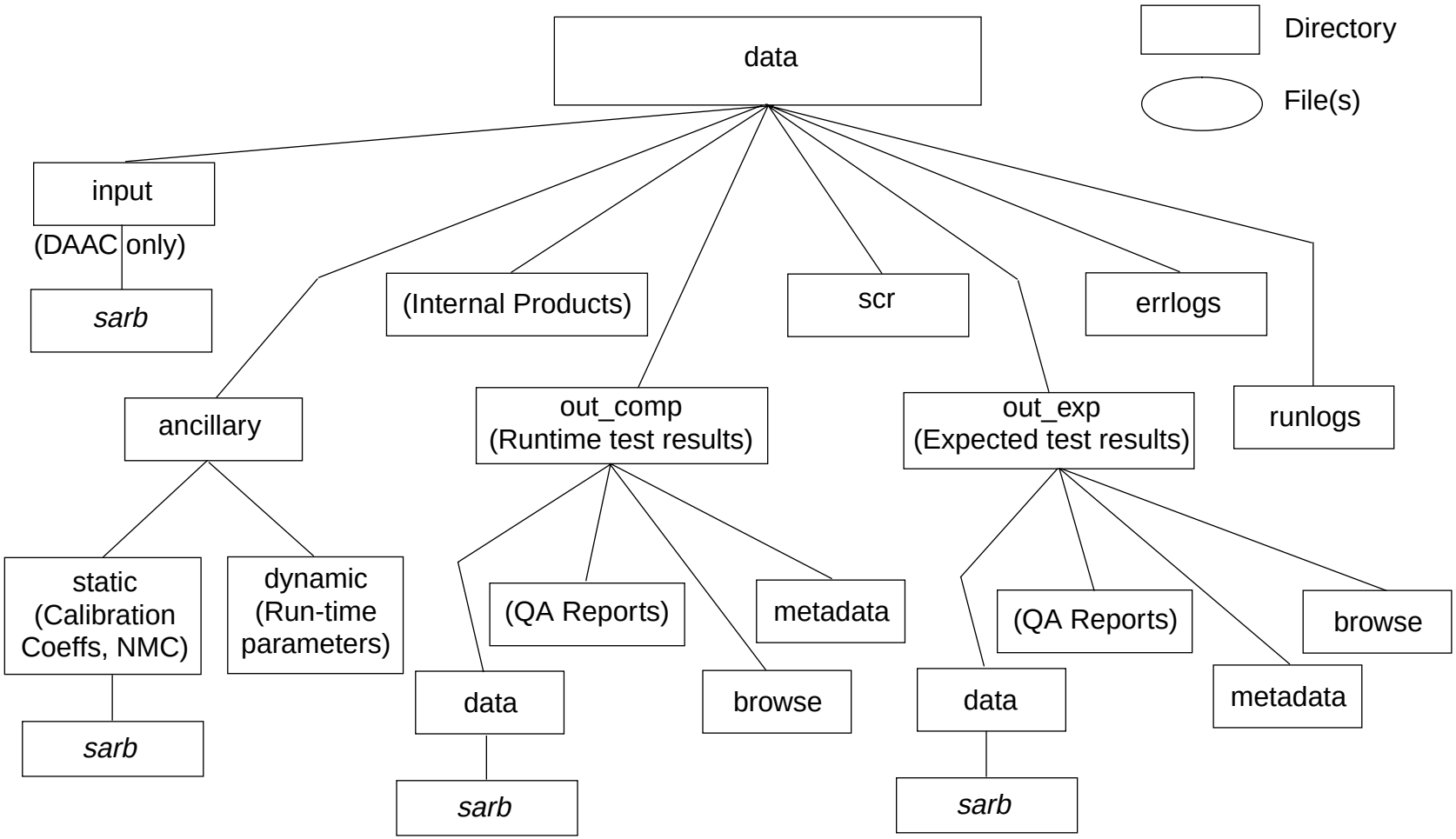
Italicized names are dependent on delivered software

*Breakdown of subdirectories shown on following pages

Names in brackets [ ] are optional files or directories

Figure B-1. Instantaneous SARB Directory Structure (1 of 3)

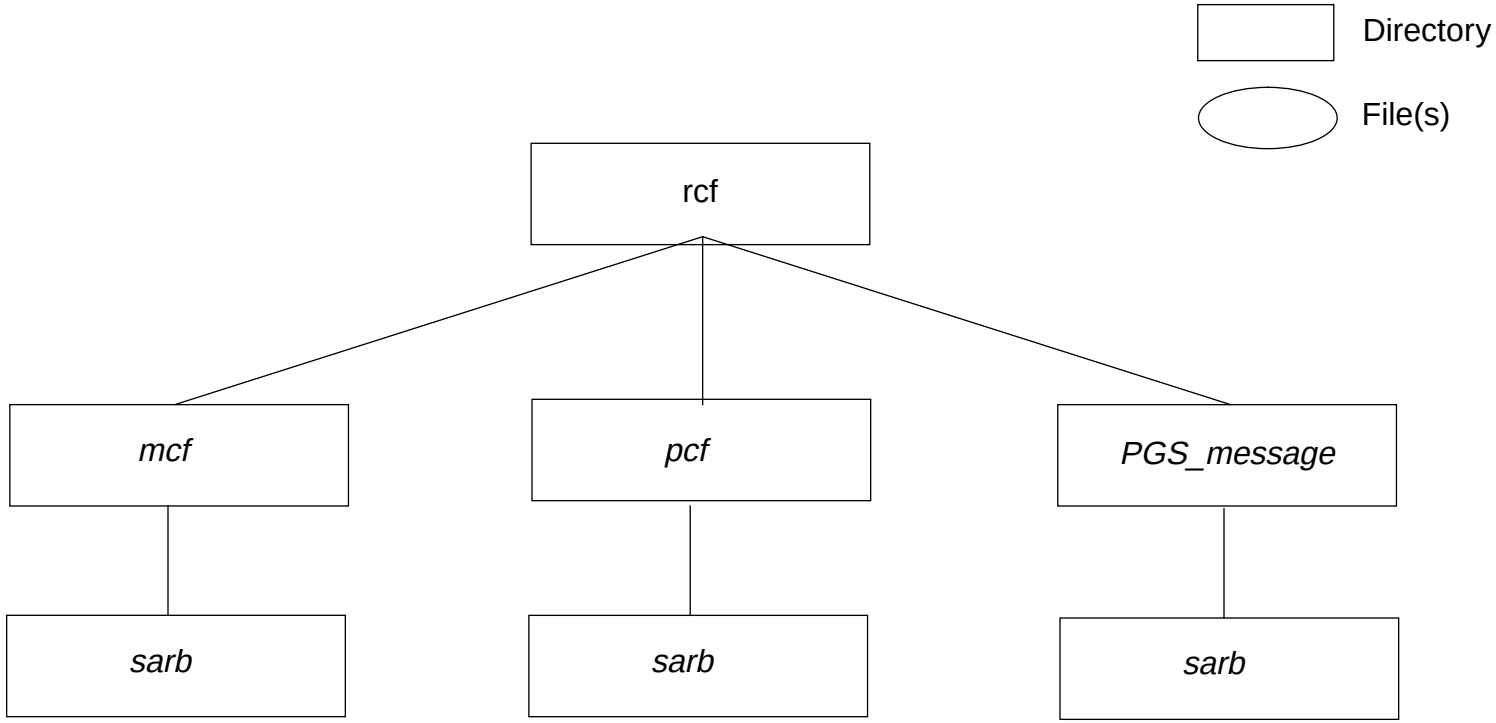
BREAKDOWN OF A DATA DIRECTORY



Italicized names are dependent on delivered software

Figure B-1. Instantaneous SARB Directory Structure (2 of 3)

BREAKDOWN OF THE INSTANTANEOUS SARB DIRECTORY STRUCTURE



Italicized names are dependent on delivered software

Figure B-1. Instantaneous SARB Directory Structure (3 of 3)

APPENDIX C
File Description Tables

C.1 Production Script and Executable

Table C.1-1. Script and Executable

File Name	Format	Description
runsarb	ASCII	C-Shell script which executes Subsystem 5.0
SARB_Drv.exe[a]	Binary	Subsystem executable

a. This file will be generated on execution of production software and is not included in the tar file.

C.2 Processing Control Files (PCF), Metadata Control Files (MCF) and Status Message Files (SMF)

With the initial delivery of the Instantaneous SARB Subsystem, metadata is not included. Metadata will be included before production processing begins.

Table C.2-1. Processing Control Files (PCF), Metadata Control Files (MCF) and Status Message Files (SMF)

File Name	Format	Directory	Description
PGS_25701[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25702[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25703[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25704[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25705[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25706[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25707[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25708[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_25709[a]	ASCII	PGS_message/sarb	Toolkit Status Message File
PGS_26513	PGS_26513	PGS_message/sarb	Toolkit Status Message File
CER5.1P1_PCF_ValidationR1_000000.1997122800	ASCII	pcf/sarb	Instantaneous SARB PCF File
crs_pcfgen.csh	ASCII	bin/sarb	PCF generator
crs_ascii_gen.csh	ASCII	bin/sarb	PCF ASCII Input file generator

a. These files are not included in the tar file

C.3 Production Source Code and Makefile

Since much of the same software is used for both the Instantaneous SARB Subsystem and the Synoptic SARB Subsystem, the production software is divided into two groups. The first group contains software that is used by only one of the two Subsystems (in this case, the Instantaneous SARB Subsystem), and the second group contains the software used by both Subsystems. Software common to both Subsystems is compiled into a library.

Table C.3-1. SARB Library Source Code (1 of 2)

File Name	Format	Version Number	Description
alblib.f90	ASCII	2.0	Type declarations and definitions for parameters used in the surface albedo correction algorithm
ceres_meteor.f90	ASCII	2.0	Routines to perform assorted meteorological calculations
Convert_OptDepth.f90	ASCII	2.0	Converts cloud optical depth to liquid water content
CSMapVal_Instant.f90	ASCII	2.0	Type declarations for SURFMAP arrays used by the surface albedo correction algorithm
DrivTab_Var.f90	ASCII	2.0	Type declarations for derivative table values
FL_SetUp.f90	ASCII	2.0	Sets up call to Fu-Liou radiative transfer model
Lev_Isolate.f90	ASCII	2.0	Isolates fluxes at output levels from flux profile
No_Cloud.f90	ASCII	2.0	Contains routine NoCloud_Profile_Build
Profile_Params.f90	ASCII	2.0	Type declarations for profile-related parameters
rad_aer2.f	ASCII	2.0	Contributed code for Fu-Liou radiative transfer model
SARB_Error_Process.f90	ASCII	2.0	Generates error messages via the Toolkit
SARB_General.f90	ASCII	2.0	General routines used by SARB
SARB_OutVar.f90	ASCII	2.0	Type declarations for variables stored on output product
SARB_QC.f90	ASCII	2.0	Contains type declarations for the SARB QC report

Table C.3-1. SARB Library Source Code (2 of 2)

File Name	Format	Version Number	Description
SARB_Var.f90	ASCII	2.0	Type declarations for variables used throughout Subsystem
SARBlib_CRS.a	Archive	2.0	SARB library for CRS Subsystem
SfcAlb_Instant.f90	ASCII	2.0	Surface albedo correction algorithm
SigTab_Var.f90	ASCII	2.0	Type declarations for sigma table values
TuneDrive.f90	ASCII	2.0	Sets up and drives tuning process
Tune_Code.f90	ASCII	2.0	Contributed code for tuning
VMax_Min.f90	ASCII	2.0	Locates maximum and minimum array values
Makefile.CRS	ASCII	2.0	Makefile to produce SARB Library

Table C.3-2. Instantaneous SARB Subsystem-only Source Code

File Name	Format	Version Number	Description
DrivIngest.f90	ASCII	2.0	Ingests the input derivative tables
Foot_Drv.f90	ASCII	2.0	Drives processing of footprint data
Init_SS5.f90	ASCII	2.0	Initializes subsystem processing
Meta_Subroutine.f90	ASCII	2.0	Reads and writes metadata
SARB_Drv.f90	ASCII	2.0	Main program
SfcAlb_Init.f90	ASCII	2.0	Drives I/O of files used by the surface albedo correction algorithm
SigmaIngest.f90	ASCII	2.0	Ingests the input sigma tables
Wrap_Up_SS5.f90	ASCII	2.0	Finalizes Subsystem processing
Makefile	ASCII	2.0	Makefile to produce executable

C.4 Ancillary Input Data

Table C.4-1. Static Ancillary Input Data

File Name	Format	Description
SS5_DrivTab_19971121	Binary	Derivative tables
CER_EICE_CERES_ValidationR1_00003.19971228	Binary	Ice map
SS5_IGBP_18_19971121	Binary	IGBP map
SigTab_Instantaneous	Binary	Sigma tables
CER_ESNOW_CERES_ValidationR1_00003.19971228	Binary	Snow map

Table C.4-2. Dynamic Ancillary Input Data

File Name	Format	Description
SfcAlb_Hist_19971227	Binary	Clear-sky surface albedo history file for December 27, 1997

C.5 Primary Input Data

Table C.5-1. Primary Input Data

File Name	Format	Description
CER_MOA_CERES_ValidationR1_000000.1997122800	Binary	Meteorological, Ozone, and Aerosol data for December 28, 1997, hour 0
CER_SSFB_TRMM-PFM-VIRS_ValidationR1_000000.1997122800	Binary	SSF file for December 28, 1997, hour 0 (CERES footprint and PSF)

C.6 Output Data Files (Expected Results)

Table C.6-1. Output Expected Results

File Name	Format	Description
CER_CRSB_TRMM-PFM-VIRS_ValidationR1_000000.1997122800	Binary	Hourly CRS output file

C.7 Output Data Files (Production Results)

Table C.7-1. Output Production Results

File Name	Format	Description
CER_CRSB_TRMM-PFM-VIRS_ValidationR1_000000.1997122800[a]	Binary	Hourly CRS output file
CER_HQCR_TRMM-PFM-VIRS_ValidationR1_000000.1997122800[a]	ASCII	Hourly Quality Control file
CER_HSALU_TRMM-PFM-VIRS_ValidationR1_000000.1997122800[a]	ASCII	Hourly clear-sky surface albedo history file
CER_CRSB_TRMM_PFM-VIRS_ValidationR1_000000.1997122800.met[a]	ASCII	Hourly metadata output file

a. These files will be generated on execution of test (comparison) software and are not included in the tar file.

C.8 Output Temporary Data Files (Production Results)

Not Applicable

C.9 Error and Status Message Files (Expected Results)

Table C.9-1. Error and Status Message Files

File Name	Format	Description
CER5.1P1_LogReport_ValidationR1_000000.1997122800[a]	ASCII	Report Log
CER5.1P1_LogStatus_ValidationR1_000000.1997122800[a]	ASCII	Status Log
CER5.1P1_LogUser_ValidationR1_000000.1997122800[a]	ASCII	Log for User messages

a This file will be generated on execution of test (comparison) software.

C.10 Test Evaluation Software

Table C.10-1. Test Evaluation Scripts and Executables

File Name	Format	Description
crscomp.exe[a]	Binary	Comparison executable

a. This file will be generated on execution of test (comparison) software.

Table C.10-2. Test Evaluation Source Code and Makefile

File Name	Format	Description
CRS_Compare.f90	ASCII	Drives comparison software
Makefile	ASCII	Makefile for comparison software

Table C.10-3. Test Evaluation Output (Test Results)

File Name	Format	Description
CER_CRSB_TRMM-PFM-VIRS_ValidationR1_000000.1997122800.Diag[a]	ASCII	Report generated by crscomp to indicate any differences found in the hourly CRS file

a. This file will be generated on execution of test (comparison) software and is not included in the tar file.